APPENDIX A

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Mobility Operating Environment System Evolution

Green Paper
The Relationship of Mobile Data and WIN Applications

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S Y S T E M S , I N C .

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A discussion Paper on the relationship between Data networks and WIN services and the use of IP addressing in the mobile environment

Abstract

A discussion on the implications of designing services that are aware of both the data (a.k.a., internet) and voice network connectivity to the mobile device and relate both to the ultimate service that will be delivered to the intended person.

Services delivered to the mobile device will grow. They will grow, however, differently than similar services in the wireline network, as mobile terminal devices are more closely associated with the person. The wireline terminal (home or business telephone) is more closely associate with a place where the intended called party just *might* happen to be. Therefore, while wireline services are tending to solve the problem of call or information delivery to the actual party, the mobile network needs to concern itself with the timely delivery of precise information that is of value to the called party at that moment and place. Establishing a delivery channel to the called party is not an issue in the wireless network.

Delivery mechanisms to the mobile device will embrace both voice and data channels. Data channels will be implemented along the model suggested by existing implementations, that is bursty data packets intertwined with the voice over a common air interface. Terminal device will either be the equivalent of laptop computers or Personal Data Assistants (PDA's) or they will be handsets with some display capability. Services provided to these devices then need to know two fundamental pieces of information: 1) the capability of the device and 2) how is it addressed. The service can then combine this information and delivery the high value service directly focused on the intended party.

Mobile devices will be known by either their Internet Protocol (IP) address or their telephone number or both. This paper discussions the implications of each and proposes an architecture that allows the service to be exposed to both networks.

Background:

The telecommunications industry is now planning for the evolution from second generation mobile radio systems to third generation UMTS systems. The promise of much greater access flexibility and bandwidth and improved support for the range of mobile multimedia services and applications is the driving force behind the current work efforts.

Today, however, mobile networks provide extensive voice and only limited data services while the capabilities of portable computers have developed to the extent that they offer real-time multimedia. If mobile networks were to offer suitable bandwidth and global connectivity today, service providers and their customers would still be unable to use mobile multimedia applications. The reason is simply that the underlying operating system and communication platforms are not ready for the challenges of mobile multimedia. Examples of these challenges are adaptation to varying quality of service, robustness in the face of disconnected links, roaming between different operators and network types, reconfigurable real-time multi-party connections, flexible coding, personalized information filtering, and support for heterogeneous user equipment. While these will be overcome, the WIN standards need to recognize a data network in the reference models.

Currently, the models assumes that the "payload" of the call or the transmission connection, is the voice traffic (or voice like data) carried over the switched link. The handset is connected to trunks or another handset more or less under the control of the switching logic or WIN services. What has not been addressed is the interaction of WIN services and data traffic. We also see the "payload" of a WIN service as data transmission without any voice traffic. In order to standardize the relationship between WIN and the data network, the data network needs to be modeled together with the WIN service.

WIN services are modeled on a call-processing concept. That is, as a call is processed, critical decision points will cause the involvement of additional applications external to the basic switch. Currently, the standards are beginning to look at decision points during, and at the end of the call that result from logic in the application, not call events such as dialing. The application triggers the interaction with the current call state independently of events or states of the call.

Examples of data only WIN services:
- Upon dialing a digit, the handset screen is downloaded with a graphic that allows the user to set or change a number of options, or profile parameters (call forwarding, call screening, information delivery services, etc.).
- The mobile enters a specific location and the local service provider downloads site specific information or mobile configuration data.
- When the mobile becomes active, investment portfolio information is sent to the mobile.
- When the mobile becomes active, updated schedule or EMAIL is downloaded to the mobile.

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The last two examples underscore the current dilemma: While these service could be developed using the Short Message Service (SMS), is it correct that data transmission related to WIN services be carried over the SS7 network when that data is not related to call control?

The use, by SMS, of the IS-41/SS7 backbone suggests that this is the model that will be followed, however, the practical aspects of this suggest that an alternative be found because of the following problems:

1. Any data node that requires the ability to send WIN related data needs to have an SS7 point code (must be setup as a message center) and be extensively tested to assure service providers that no network problems will arise.

2. In the limit that wireless handsets will be multimedia, data can come from many sources including the handsets themselves. Currently, the handset is identified by its MIN while the data source node is identified by its point code. No model exists for addressing data between handsets other than dialing the other device or through a mobile originated SMS. These conflict with WIN services that wish to support both voice and data. Furthermore, as data is bursty, WIN data should not build in the inefficiencies of the landline ISDN circuit switched model.

3. The SS7 network is designed to transmit call control information in a very timely fashion. There are severe implications to call processing if the data is delayed and retries are need. The data associated with WIN service does not have this constraint. WIN service data does not usually need to arrive within seconds given that the end user usually has no idea when the trigger initiating the data was launched. Data response times similar to those on the Internet are adequate. More important than split second speed is the ability to move large block of data. Therefore, the inherent structure of the SS7 network will be overloaded, as the WIN Data traffic becomes dominant.

4. SS7 connections are generally more expensive than TCP/IP connections. Tables related to the telephone number drive the routing of messages. This would be a problem if data were to be sent to a device know only by it IP address.

5. SMS messages were designed to convey short blocks of text to allow the incorporation of text pager functions into the handset. Modifying the SMS message structure will add complexity and overhead to the IS-41 protocol that makes this method very inefficient.

The data capabilities that are required between the mobile and the network require not only the classical switched ISDN type service, but the connection-less Internet type

accesses. This paper discusses the issues that need to be overcome if applications are to be designed that will take advantage of a connections-less data network.

The Internet and WIN: A services perspective

To develop services that fully utilize the data and voice network, and take advantage of both the inherent mobility services in the mobile network and the proposed mobility functions in the Internet, a model for these combined networks needs to be agreed to. Currently, a data connection is not controllable by the wireless network application other than setting the call up or tearing it down. Wireless data implementations are currently overlay technologies that are modeled independent of each other. For the technology to truly grow, the fundamental network models need to incorporate both network attributes at the very start of the design of the data and voice network interoperability.
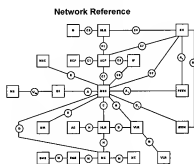
The integration of voice and data networks has long been the Holy Grail of the telecommunications industry but so far, has not been realizable at the service level. The wireless industry has the opportunity to take the lead in this area and develop network-based applications that are truly universal.

As a starting point, consider that applications will need to key on the following parameters:

1. **The identity of the mobile device**: Will applications address it by a fixed IP address or a telephone number or both?

2. **Control of the data network**: How will the application know either the capabilities or activity that the mobile is generating or encountering in the data network.

The voice networks (i.e. wireless voice networks) are following the lead of the ITU with the CS concept. The Internet is evolving its own, essentially, needs based solution to mobility. This paper puts forth the challenge to incorporate the Internet ideas into the network models of the wireless network and as well as to incorporate the wireless models into the Internet development.
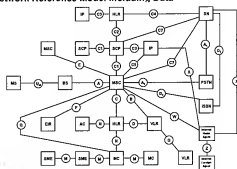
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Proposed network reference model:

Figure 1

Figure 2

Figure 1 shows the existing WIN network reference model. Figure 2 shows the changes from the existing WIN reference model that includes the data network. This model assumes that the data network will support the proposed mobile IP as generally described in Internet Engineering Task Force, RFC2002. The RFC2002 proposes the introduction of Home and foreign agents. These are roughly analogous to HLR and VLR. The attached reference model shows relationships to these agents in the similar manner as Service Nodes and Intelligent Peripherals have to the HLR. For example, the reference model will allow applications to query the Home or Foreign Agent on the profile or current status of the mobile device. It also allows mobile devices their own identity, either its telephone number or its IP address.

Figure 3 proposes a physical implementation of the reference model. By considering this design, the reader is encouraged to consider these ideas in the broader context of expanded capabilities. This implementation is consistent with Mobile Switching Centers (MSC) becoming servers on a network of multiple processors.

Addressing the mobile device:

Services developed for the mobile device need to consider how the device will be known or addressed. In the voice world, the telephone number assigned to the device becomes the device addresses. All calls to the mobile are routed to the home switch by the PSTN (based on the assigned telephone number). The home switch then routes the call to the current location of the mobile. Trunking inefficiencies are known to occur especially if the calling and called party are both in an area that is not the called party home area. Should an application need to send data to the mobile, the application also needs to

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address the device. Typically, all parties know a mobile phone by its phone number or by the person who is normally associated with the telephone. Therefore, it seems logical that the application also references the mobile by the same attributes. If the mobile device is a computer, it needs to be known by a unique name that is associated with a particular domain. Certainly, the computer name could be arbitrarily the phone number of the associated telephone. While this could be made to work, in the limit such a naming convention would lead to problems in the future.

Another naming convention could see the mobile device being identified by an IP address. These could be either public or private IP addresses. With the limit on public IP addresses, it seems highly unlikely that dedicated IP addresses will be assigned to the mobile (i.e. all mobile devices including those not currently active with data connectivity), resulting in the mobile being assigned a private IP. A private IP will need to be translated into public ones for routing. Given that this needs to be done anyway, one might as well use the telephone number as the private IP address. The final resolution of what the actual mobile data address will become is outside the scope of this document. This document only assumes that mobile devices capable of connection-less data connectivity will have a unique address imbedded in the mobile that the mobile can broadcast when it becomes active on the network.

Feature operation:

It is helpful to examine a number of features and how they would operate to define the issues that will exist in the development of services based on mobile IP. This discussion concerns itself over features that are based in both WIN and data networks.

Dial activated data service:

In this service, the user will dial a specific sequence of digits to request a specific piece of information to be sent to the mobile phone.

The sequence of events is as follows:

1. User dials a specific number, say ##46835 (the stock price of Intel)
2. The WIN service application is invoked by the Origination trigger for ## and recognizes this dialed sequence as a request to send the stock price for Intel to the subscriber (MIN from the OriginationRequest message).
3. The application launches the request for the message to the financial service provider and obtains the result over an appropriate data network.
4. The WIN application now combines this information into a short message and launches the message to the mobile device as a standard SMS message.

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5. Mobile receives the requested data as a normal SMS message.

The use of the SMS feature is convenient and in this case, also appropriates. However, suppose the request results in a message length greater than that allowed by the SMS. Consider the following example:

1. User dials a specific number, say ##46835 (the stock price of Intel)
2. The WIN service applications is invoked by the Origination trigger for ## and recognizes this dialed sequence as a request to send the stock price for Intel to the subscriber (MIN from the OriginationRequest message).
3. The application launches the request for the message to the financial service provider and obtains the result over an appropriate data network.
4. The WIN application bundles the information into an Internet Push message and launches it to the mobile. (data is larger than the SMS allowed message length)
5. It obtains the mobile's Internet mobile address by asking the HLR for the matching IP address on the known MIN or it obtains the it from a modified Origination Message. It could also get it from the Home agent or it can get the temporary address from the foreign agent. This latter source will allow routing to be more direct and could improve response times.
6. Routing of the Internet message is then completed is suggested in RFC2002 to the foreign agent.

There are a few items currently missing in this scenario. The HLR currently does not track the IP address for the mobile nor does the Origination Message support it. Furthermore, the IP address and the MIN are both unique to the phone. Therefore, the administration of this key will double.

The OriginationRequest could contain the IP address of the mobile, however, this will require that the air interface and the switches need to be modified to add in this identifier. Again this redundant work as the MIN is already unique.

Given that the WIN application knows where the mobile is (from the OriginationRequest message MSCID) it could inquire of the foreign agent and obtain the direct IP currently assigned to the mobile in a manner similar to how mobiles are contacted via a TLDN. This is only useful if the WIN application has control of the data stream to the mobile as it will have to insert the temporary IP address into the message.

What happens when the mobile is not available?

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WIN services are based on the general telephony protocol that services are supported under all conditions. For example, the service of call delivery is also supported when the called party is not answering. The call is completed through the use of voice mail. Call forward busy handles the situation when the caller is busy. Voice mail also handles the call when the mobile is unreachable. The current proposal for mobile IP (RFC2002) addresses the problem of mobility, but fails to address the problem when the mobile is not available. WIN based applications will be aware of the status of the mobile. When the mobile device is not available the WIN application could registers itself with the Home agent announcing itself as the foreign agent. All future datagrams sent to the mobile will be redirected to the WIN applications that can now implement the equivalent to voice mail for data traffic.

Here is an example of why this is needed.

1. The subscriber has requested regular information, baseball scores by inning for example.

2. At the end of each inning, the score is downloaded.

3. Part way through the game, the mobile is turned off.

4. When the mobile is again active on the network, the system sends only the most recent score and continues from that point.

To implement this feature today, the SMS Message center has to be aware of the specific attributes of the service. Therefore, standard SMS platforms cannot support a service such as described above. By having the WIN application register with the Home agent, the WIN application can implement this type of filtering without the host application being modified.

This service would work as follows:

1. The subscriber requests the baseball scores by any one of a number of means, subscription, specific dialed number or Web based profile control.

2. This request is provisioned on the WIN application.

3. The WIN application processes a specific request to the information service provider of the baseball scores.

4. The data is returned when available.

5. The WIN application forwards the data only if the mobile is ready to receive it.

6. If the mobile is not ready, the WIN application handles the data based on criteria that are set by the service. This can be considered as data type and can be:

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- Oldest first, causing the data to be sent in order based on the oldest message first.
- Newest first, causing the data to be sent in order based on the newest message first.
- Latest only, causing only the last data to be sent.

7. The data type can be computed by the WIN application based on the service request. The WIN application will provide this support allowing existing information sources to remain unchanged.

8. The WIN application can also forward the data to other terminals based on any criteria such as mobile ability. For example, if the service requested results in too much data for the mobile, the overflow information can be sent via EMAIL to another site.

Requirements for the handset

Connection-less address:

Each mobile requires an address that can receive data whenever the mobile is active and on the network. This mobile address must be available to the WIN application. In the same way that a voice caller dials the MIN and gets connected to the end user, an application must be able to address the mobile and communicate with the onboard processor.
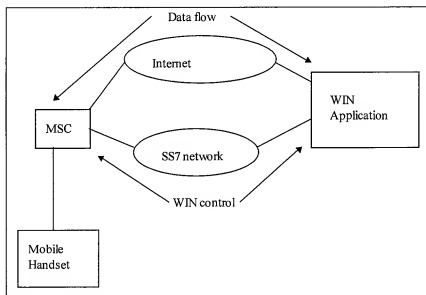
Data connectivity:

Communications to the handset must be available without a call active. The data connection shall be able to support single messages to at least 144kbps. The channel capacity of the data connection shall be independent of the call status.

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Data Network Access at the MSC:

Each MSC will require connectivity to the shared network access. While connection to the Internet is assumed in this document, more than one data network can be used or a single private network. The MSC must provide the connection from this network to the

data stream to the mobile unit.

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Summary of Requirements:

Applications that are aware of both the data and voice network will be able to develop a broad range of services. However, in order for this to be achieved, we need additional capabilities:

1. The WIN reference model must include the Internet and access from application platforms.
2. Home and foreign agents should support inquires that return the currently assigned IP or agent.
3. The wireless switch must have the ability to connect the mobile device to the Internet independent of the call status.
4. The mobile must be addressable by the IP address or the MIN or both depending on the requirements of the application.

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